METRIC
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MILITARY SPECIFICATION

FIBER, OPTICAL, GENERAL SPECIFICATION FOR (METRIC)

This specification is approved for use by the Naval Sea Systems Command based upon currently available technical information, but it has not been approved for promulgation as a coordinated revision of MIL-F-49291. It is subject to modification. However, pending its promulgation as a coordinated military specification, it may be used in acquisition.

1. SCOPE

1.1 Scope. This specification covers the performance requirements and characteristics for silica-based optical fibers which are to be used as transmission media for Naval shipboard applications. The fiber is defined as the core, cladding, and the protective coatings applied during the fiber drawing process. This specification also covers fibers to be used as pigtails.

1.2 Classification. Optical fibers (see 6.5.19) covered by this specification are classified as specified in 1.2.1 and 1.2.2.

1.2.1 Optical fiber type. The optical fiber type designation defines the nature of the refractive index profile, the composition of the optical fiber core/cladding (see 6.5.5 and 6.5.16), and the mode volume of the optical fiber as shown in table I.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5105 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6010

TABLE I. Fiber type designation.

Fiber type	Letter
Graded index, glass core and glass cladding, multimode (see 6.5.18)	MM
Dispersion-unshifted (see 6.5.13), glass core and and glass cladding, single-mode (see 6.5.22)	SU
Dispersion-shifted (see 6.5.14), glass core and glass cladding, single-mode	SS
Dispersion-flattened (see 6.5.12), glass core and glass cladding, single-mode	SF

1.2.2 Optical fiber core and cladding diameter. The optical fiber core and cladding designation defines the diameter of the optical fiber core and cladding as shown in table II.

TABLE II. Optical fiber core and cladding diameter.

Core and cladding diameter in micrometers (μm)	Designation
8.5 - 10.0/125 (single-mode) 1/	A
62.5/125 (multimode)	B

1/ Nominal mode field diameter at 1.310 ± 0.020 μm.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL-C-12000 - Cable, Cord, and Wire, Electric; Packaging of.

STANDARDS

FEDERAL

FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

- 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
- 455-13 - Visual and Mechanical Inspection of Fibers, Cables, Connectors and/or Other Fiber Optic Devices. (DoD adopted)
- 455-20 - Measurement of Change in Optical Transmittance. (DoD adopted)
- 455-31 - Fiber Tensile Proof Test Method. (DoD adopted)
- 455-45 - Microscopic Method for Measuring Fiber Geometry of Optical Waveguide Fibers. (DoD adopted)
- 455-46 - Spectral Attenuation Measurement for Long Length, Graded-Index Optical Fibers. (DoD adopted)
- 455-47 - Output Far-Field Radiation Pattern Measurement. (DoD adopted)
- 455-49 - Procedure to Measure Nuclear Radiation Effects in Fiber Optic Components.
- 455-50 - Light Launch Conditions for Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurement. (DoD adopted)
- 455-51 - Pulse Distortion Measurement of Multimode Glass Optical Fiber Information Transmission Capacity. (DoD adopted)
- 455-54 - Mode Scrambler Launch Requirements for Information Transmission Capacity Measurements.
- 455-58 - Core Diameter Measurement of Graded-Index Optical Fibers. (DoD adopted)
- 455-59 - OTDR Measurement of Fiber Point Defects.
- 455-62 - Optical Fiber Macrobend Attenuation.
- 455-63 - Torsion Test for Optical Waveguide Fiber. (DoD adopted)
- 455-65 - Optical Fiber Flexure Test.
- 455-70 - Advanced Aging (Temperature) for Optical Fibers.
- 455-71 - Procedure to Measure Temperature Shock Effects on Fiber Optic Components.
- 455-73 - Procedure to Measure Temperature and Humidity Cycling Effects on Fiber Optic Components.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA) (Continued)

455-78 - Spectral Attenuation Cut-Back Measurement for Single-mode Optical Fibers.

455-80 - Cut-off Wavelength of Uncabled Single-Mode Fiber by Transmitted Power.

455-164 - Single-mode Fiber, Measurement of Mode Field Diameter by Far-Field Scanning.

455-168 - Chromatic Dispersion Measurement of Multimode Graded Index and Single-mode Optical Fibers by Spectral Group Delay Measurement in Time Domain.

(Application for copies should be addressed to the Electronic Industries Association, 2001 Eye Street NW, Washington, DC 20006.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 First article. When specified (see 6.2), samples shall be subjected to first article inspection (see 6.4) in accordance with 4.4.

3.3 Materials. The fiber shall be composed of pure or doped silica glass covered by a protective coating (see 6.5.7). The core material shall have a higher index of refraction than the cladding material. Materials selected for fibers shall be of a type and quality to assure compliance with the requirements of this specification, and shall be physically and chemically compatible for their intended use throughout the intended lifetime which shall be not less than 20 years. Materials used shall be electrically nonconductive. Where new or questionable material is being considered for use, the manufacturer shall furnish the toxicological data and formulations required to evaluate the safety of the material for the proposed use. Materials used in fiber construction shall not emit toxic or explosive fumes when exposed to high temperature or flame. The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the Naval Medical Command (NAVMEDCOM) who will act as an advisor to the contracting activity.

3.3.1 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new. Products may be fabricated using raw materials produced from recovered bulk materials to the extent practicable if the intended use of the product is not jeopardized. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become part of a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of partially processed, assembled, used or rebuilt products are allowed under this specification.

3.3.2 Material safety data sheet (MSDS). The contracting activity shall be provided a material safety data sheet at the time of contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.6).

3.4 Design.

3.4.1 Optical fiber. The optical fiber core and cladding shall be composed of silica glass (SiO_2) with dopants as required. The coating shall be composed of a single or multiple layers and shall be processed in such a manner as to ensure the material passes all required tests. When specified (see 3.1), the coating shall hermetically seal the core and cladding of the fiber.

3.4.1.1 Type MM fiber. Type MM optical fiber shall be multimode and shall be made of silica-based glass with refractive index profile consisting of a graded refractive index core and a cladding as specified (see 3.1).

3.4.1.2 Type SU fiber. Type SU optical fiber shall be dispersion unshifted, single-mode fiber and shall be made of silica-based glass with a constant homogeneous refractive index core of a higher refractive index than the cladding as specified (see 3.1). Type SU also includes a fiber with a concentric area, or inner cladding around the core, and shall have a lower refractive index than that of the outer cladding. The design shall be either a depressed cladding (see 6.5.11) or matched cladding design (see 6.5.17).

3.4.1.3 Type SS fiber. Type SS optical fiber shall be dispersion-shifted, single-mode fiber, and shall be made of silica-based glass consisting of a core with a triangular refractive index profile or other type of profile, and with a higher refractive index than the cladding as specified (see 3.1).

3.4.1.4 Type SF fiber. Type SF optical fiber shall be dispersion-flattened, single-mode fiber, and shall be made of silica-based glass consisting of a refractive index profile as specified (see 3.1).

3.5 Construction. Unless otherwise specified (see 3.1), the construction of the fiber shall be as specified herein (see 4.6.3).

3.5.1 Optical fibers. Fibers shall be sufficiently free of imperfections, inclusions and impurities other than dopants, to conform to the strength and optical transmission requirements. The optical fiber shall be coated with a material that will preserve the high pristine tensile strength of the glass fiber. The optical fiber type, core, and cladding sizes shall be as specified (see 3.1). Unless otherwise specified (see 3.1 and 6.2), the fibers shall be splice-free in lengths of at least 2.2 kilometers (km).

3.5.1.1 Geometry (fiber). The core and cladding diameters, core and cladding noncircularity (see 6.5.6 and 6.5.9), and core/cladding offset (see 6.5.8) for types MM, SU, SS, and SF fibers shall be as specified in table III (see 4.6.3.1).

TABLE III. Fiber geometry.

Fiber type	Core diameter (μm)	Cladding diameter (μm)	Mode field diameter (μm)	Core non-circularity (percent)	Cladding non-circularity (percent)	Core/ cladding offset (μm)
MM	62.5 ± 3.0	125 ± 2.0	--	≤ 6.0	≤ 2.0	≤ 4.0
SU	-	125 ± 2.0	9.25 ± 0.75	-	≤ 2.0	≤ 1.0
SS	-	125 ± 2.0	7.85 ± 0.85	-	≤ 2.0	≤ 1.0
SF	-	125 ± 2.0	see 3.6.1.7	-	≤ 2.0	≤ 1.0

3.5.1.2 Geometry (coating). The protective coating diameter, coating noncircularity, and the fiber/coating offset ratio (see 6.5.15) shall be as specified in table IV (see 4.6.3.1).

TABLE IV. Fiber coating geometry.

Coating diameter (μm)	Coating noncircularity (percent)	Fiber/coating offset ratio
250 ± 15	≤ 10	≥ 0.7
500 ± 25	≤ 10	≥ 0.65
900 ± 50	≤ 10	≥ 0.65

3.5.2 Tensile proof. The tensile proof strength shall be not less than 690 megapascals (MPa) (see 4.6.3.2).

3.5.3 Mechanical strippability. The fiber coating shall be mechanically strippable with commercially available stripping tools. There shall be no residual coating material on the stripped fiber after wiping with a dry cotton cloth (see 4.6.3.3).

3.6 Performance.

3.6.1 Optical properties.

3.6.1.1 Change in optical transmittance. The change in optical transmittance for the specified sample specimen shall be not greater than 0.5 decibel (dB) for type MM fiber and 0.3 dB for types SU, SS, and SF fiber (see 4.6.4.1).

3.6.1.2 Attenuation rate. Unless otherwise specified (see 3.1), the fiber attenuation rate (see 6.5.1 and 6.5.2) shall be as specified in table V (see 4.6.4.2). The fiber attenuation rate for type SF fiber shall be as specified (see 3.1).

TABLE V. Attenuation rate.

Fiber type	Wavelength (μm)	Attenuation rate (dB/km)
MM	1.310 $\pm$ 0.020	$\leq$ 1.0
SU	1.310 $\pm$ 0.020	$\leq$ 0.6
SS	1.550 $\pm$ 0.025	$\leq$ 0.5

3.6.1.3 Attenuation uniformity. There shall be no discontinuities in attenuation along the length of the multimode fiber greater than 0.2 dB and no discontinuities in attenuation along the length of the single-mode fiber greater than 0.1 dB, for the specified wavelength (see 4.6.4.3).

3.6.1.4 Numerical aperture (for type MM fiber only). The numerical aperture of multimode fibers shall be 0.275 $\pm$ 0.015 (see 4.6.4.4).

3.6.1.5 Bandwidth-distance product (for type MM fiber only). The multimode fiber bandwidth-distance product (see 6.5.3) shall be not less than 350 megahertz-kilometer (MHz-km) at 1.310 $\pm$ 0.020 μm (see 4.6.4.5).

3.6.1.6 Macrobend attenuation. The macrobend attenuation for type MM fiber shall be not greater than 0.5 dB, and the macrobend attenuation for types SU, SS, and SF fiber shall be not greater than 0.1 dB at 1.310 $\pm$ 0.020 μm and 1.0 dB at 1.550 $\pm$ 0.025 μm (see 4.6.4.6).

3.6.1.7 Mode field diameter (for types SU, SS, and SF fibers only). The nominal mode field diameter of type SU fiber shall be between 8.5 and 10.0 μm, with a tolerance of plus or minus 10 percent. The nominal mode field diameter of type SS fiber shall be between 7.0 and 8.7 μm, with a tolerance of plus or minus 10 percent. The nominal mode field diameter of type SF fiber shall be as specified (see 3.1) (see 4.6.4.7).

3.6.1.8 Dispersion. The zero dispersion wavelength of type SU fiber shall be 1.310 ± 0.015 µm with a maximum dispersion value of 3.5 picoseconds/nanometer-kilometer (ps/nm-km) from 1.290 to 1.330 µm, and 20 ps/nm-km at 1.550 ± 0.025 µm. The value of the dispersion slope at the zero dispersion wavelength shall be not greater than 0.1 ps/nm^2-km. The dispersion characteristic for type SS and SF fiber shall be as specified (see 3.1) (see 4.6.4.8).

3.6.1.9 Cut-off wavelength (for types SU, SS, and SF fibers only). Unless otherwise specified (see 3.1), the cut-off wavelength (see 6.5.10) of types SU, SS, and SF fiber shall be between 1.130 and 1.330 µm (see 4.6.4.9).

3.6.1.10 Transient attenuation (for type MM fibers only). The transient attenuation (see 6.5.23) of the type MM fiber shall be not greater than 1.0 dB (see 4.6.4.10).

3.6.2 Mechanical properties.

3.6.2.1 Torsion. The fiber shall not exhibit damage and the change in optical transmittance shall not exceed the requirements of 3.6.1.1 (see 4.6.5.1).

3.6.2.2 Flexure. The fiber shall not exhibit damage and the change in optical transmittance shall not exceed the requirements of 3.6.1.1 (see 4.6.5.2).

3.6.3 Environmental properties. The optical fiber shall meet all requirements specified (see 3.1) during the specified operating environments and after the specified storage environment. The operating temperature range and storage temperature shall be as shown in table VI, as specified (see 3.1).

TABLE VI. Temperature ranges (ambient).

Range	Operating (°C)	Storage (°C)
1	-54 to +85	-62 to +85
2	-28 to +85	-62 to +85

3.6.3.1 Thermal shock. There shall be no cracking or melting of the fiber coating material, and the change in optical transmittance shall not exceed the requirements of 3.6.1.1. The mechanical strippability requirements of 3.5.3 shall be met (see 4.6.6.1).

3.6.3.2 Temperature-humidity cycling. There shall be no swelling or softening of the coating material and the change in optical transmittance shall not exceed the requirements of 3.6.1.1. The mechanical strippability requirements of 3.5.3 shall be met (see 4.6.6.2).

3.6.3.3 Accelerated aging. The change in optical transmittance shall not exceed the requirements of 3.6.1.1. The mechanical strippability requirements of 3.5.3 shall be met (see 4.6.6.3).

3.6.3.4 Nuclear radiation resistance. Unless otherwise specified (see 3.1), the finished fiber shall meet the requirements specified (see 3.1). The change in optical transmittance shall be not greater than 50 decibels per kilometer (dB/km) 5 seconds after exposure ceases and 5 dB/km 1000 seconds after exposure ceases (see 4.6.6.4).

3.7 Identification marking. Unless otherwise specified (see 6.2), the fiber shall be identified by a marking applied to one end of each reel or spool (see 4.6.7). When specified (see 6.2), a color code coating of the optical fiber shall be as specified (see 3.1 and 4.6.2).

3.8 Workmanship. Fibers shall be dimensionally uniform, free of lumps, kinks, splits, scraped or abraded surfaces, splices, and inclusions.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) First article inspection (see 4.4).
(b) Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in applicable portions of EIA-455.

4.4 First article inspection. First article inspection shall consist of all the tests listed in table VII and as specified (see 3.1).

TABLE VII. First article inspection.

Inspection	Requirement	Test method	Sample length
Group I			
Visual and mechanical	3.3, 3.5 3.7, 3.8	4.6.2	1 km 1/
Geometry	3.5.1.1 3.5.1.2	4.6.3.1	2/
Tensile proof	3.5.2	4.6.3.2	2/
Attenuation rate	3.6.1.2	4.6.4.2	2/
Attenuation uniformity	3.6.1.3	4.6.4.3	2/
Numerical aperture	3.6.1.4	4.6.4.4	2/
Bandwidth-distance product	3.6.1.5	4.6.4.5	2/
Macrobend attenuation	3 6.1.6	4.6.4.6	2/
Mode field diameter	3.6.1.7	4.6.4.7	3/
Dispersion	3.6.1.8	4.6.4.8	2/
Cut-off wavelength	3.6.1.9	4.6.4.9	3/
Mechanical strippability	3.5.3	4.6.3.3	4/
Group II			
Transient attenuation	3.6.1.10	4.6.4.10	1 km
Thermal shock	3.6.3.1	4.6.6.1	1 km
Temperature-humidity cycling	3.6.3.2	4.6.6.2	5/

See footnotes at end of table.

TABLE VII. First article inspection - Continued.

Inspection	Requirement	Test method	Sample length
Accelerated aging	3.6.3.3	4.6.6.3	5/
Torsion	3.6.2.1	4.6.5.1	6/
Flexure	3.6.2.2	4.6.5.2	6/
Group III			
Nuclear radiation resistance	3.6.3.4	4.6.6.4	7/

1/ A 10-meter specimen shall be used from the 1-km length.
2/ The same 1-km samples shall be used as in visual and mechanical inspection.
3/ A 2-meter specimen cut from each sample shall be used.
4/ A 1-meter specimen cut from each sample shall be used.
5/ The same sample shall be used as in the thermal shock inspection.
6/ A 10-meter specimen shall be cut from sample in group I.
7/ A specimen greater than 100 meters shall be cut from sample in group I.

4.4.1 Sample. A finished optical fiber sample shall be submitted for each fiber construction for which first article approval is desired. The sample submitted shall be three 1-km lengths with no splices.

4.4.2 Inspection routine. The samples shall be subjected to the first article inspection specified in table VII in the order shown. Tests that are not specified as applicable to a specific fiber construction shall not be conducted. Sample units shall be subjected to the inspection of group I. Specimens shall be cut from each sample unit in lengths not less than those specified in table VII for each inspection. Test specimens from each sample unit shall be subjected to the tests of groups II and III of table VII.

4.4.3 Failures. One or more failures shall be sufficient cause for refusal to grant first article approval.

4.5 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified for group A inspection (table VIII), group B inspection (table IX), and group C inspection (table X).

4.5.1 Group A inspection. Group A inspections shall follow the order shown in table VIII.

TABLE VIII. Group A inspections.

Inspection	Requirement	Test method	Sample length
Visual and mechanical	3.3, 3.5 3.7, 3.8	4.6.2	1 km 1/
Geometry	3.5.1.1 3.5.1.2	4.6.3.1	2/
Tensile proof	3.5.2	4.6.3.2	2/
Attenuation rate	3.6.1.2	4.6.4.2	2/
Attenuation uniformity	3.6.1.3	4.6.4.3	2/
Numerical aperture	3.6.1.4	4.6.4.4	2/
Bandwidth-distance product	3.6.1.5	4.6.4.5	2/
Mode field diameter	3.6.1.7	4.6.4.7	3/
Dispersion	3.6.1.8	4.6.4.8	2/
Cut-off wavelength	3.6.1.9	4.6.4.9	3/

1/ A 10-meter specimen shall be used from each 1-km unit.
2/ The same 1-km unit shall be used as in the visual and mechanical inspection.
3/ A 2-meter specimen cut from each length used in the visual and mechanical inspection.

4.5.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table IX. Group B inspections shall be made on units that have passed the group A inspection.

TABLE IX. Group B inspections.

Inspection	Requirement	Test method	Test length
Thermal shock	3.6.3.1	4.6.6.1	1 km
Macrobend attenuation	3.6.1.6	4.6.4.6	1/
Torsion	3.6.2.1	4.6.5.1	10 meters
Flexure	3.6.2.2	4.6.5.2	10 meters

1/ The same units shall be used as in the thermal shock inspection.

4.5.3 Group C inspections. Group C inspections shall consist of the examinations and tests listed in table X. Group C inspections shall be made on units that have satisfactorily completed all group A and group B inspections. Specimens for group C inspections shall be obtained from the lengths specified (see 3.1).

TABLE X. Group C inspections.

Inspection	Requirement	Test method	Test length
Temperature-humidity cycling	3.6.3.2	4.6.6.2	1 km
Accelerated aging	3.6.3.3	4.6.6.3	1 km
Nuclear radiation resistance	3.6.3.4	4.6.6.4	≥ 100 meters

4.6 Methods of inspection.

4.6.1 Equivalent test methods. The use of equivalent test methods is allowed (see 3.1 and 6.2).

4.6.2 Visual and mechanical examination. The optical fiber shall be inspected in accordance with EIA-455-13 to verify that the design, construction, physical characteristics and dimensions, marking, and workmanship are in accordance with the requirements of 3.3, 3.5, 3.7, and 3.8.

4.6.3 Construction.

4.6.3.1 Fiber and coating geometry. Fiber geometry, including core noncircularity, cladding diameter, cladding noncircularity, and core/cladding offset shall be determined in accordance with EIA-455-45, method B (photographic) or equivalent (see 4.6.1). The core diameter of the multimode fiber shall be determined in accordance with EIA-455-58 or equivalent (see 4.6.1). Coating geometry, including coating diameter and coating noncircularity, shall be determined in accordance with appendix A of this specification (see 6.3 and appendix B). Fiber (core/cladding) to coating offset ratio shall be determined by measuring the minimum wall thickness (t_{min}) and the maximum wall thickness (t_{max}) and dividing the minimum by the maximum value (see figure 1). The fiber and coating geometry shall meet the requirements specified in 3.5.1.1 and 3.5.1.2.

Fiber/coating offset ratio - t_{min}/t_{max}

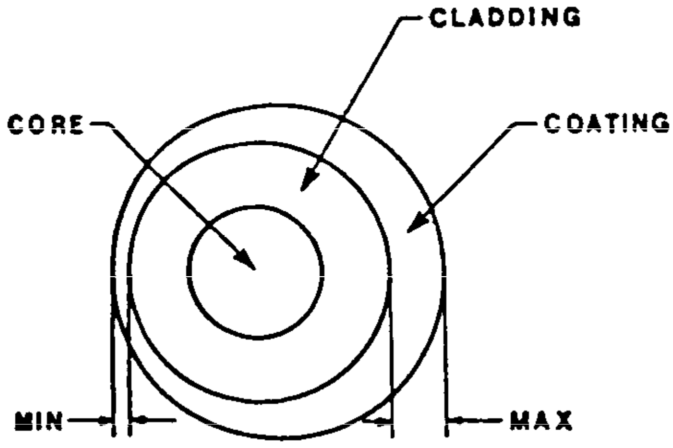

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FIGURE 1. Fiber/coating offset ratio.

4.6.3.2 Tensile proof. Fiber proof test characteristics shall be determined in accordance with EIA-455-31. Tensile-proof strength shall be as specified in 3.5.2.

4.6.3.3 Mechanical strippability. Fibers shall be stripped of their coatings using a commercially available mechanical fiber stripper. After stripping, the fiber shall be inspected under 100X magnification for conformance to 3.5.3.

4.6.4 Optical properties. Unless otherwise specified (see 3.1), the optical properties shall be measured at a wavelength of 1.310 ± 0.020 μm.

4.6.4.1 Change in optical transmittance. This test shall evaluate the change in optical transmittance of the fibers caused by exposure to environmental and physical tests.

4.6.4.1.1 Method. The change in optical transmittance of each fiber shall be measured in accordance with EIA-455-20 or equivalent (see 4.6.1) using a monitor fiber, taken from the same sample as the fiber under test. For type MM fiber, the source used shall be noncoherent. The appropriate launch conditions as indicated in table XI shall be used.

TABLE XI. Light launch conditions for attenuation tests.

Fiber type	Launch condition
SU, SS, SF	30-mm diameter mandrel
MM	70/100 restricted, or 70/70 restricted (see 6.5.20 and 6.5.21)

Any optical power detection method may be used if the method is sufficiently sensitive to measure the differential optical power levels as specified (see 3.6.1.1), and if the method provides repeatable readings (less than 3 percent variation). A pretest optical power measurement shall be made and the specimen shall then undergo inspection testing. All optical power measurements, subsequent to the pretest measurement, shall be referenced to the pretest value and the change in dB shall be calculated. The change in optical transmittance shall be in accordance with 3.6.1.1.

4.6.4.1.2 Guidelines. These types of measurements require highly stable optical devices (source and detector) and repeatability of loss at the device-to-fiber interface. Use of the same reference fiber for calibrating the light source power output just prior to making all the measurements on the specimen will enhance the measurement accuracy.

4.6.4.2 Attenuation rate. The attenuation rate of each individual fiber shall be measured at 1.310 $\pm$ 0.020 μm in accordance with EIA-455-46 for multimode fiber (type MM). For multimode fiber, the source used shall be noncoherent. Light launch conditions used during the attenuation rate measurements for the multimode fiber shall be in accordance with EIA-455-50 and table XI. The attenuation rate of each individual single-mode fiber, at each specified wavelength, shall be measured in accordance with EIA-455-78, and a higher order mode filter in accordance with table XI shall be used. Attenuation rate shall be as specified in 3.6.1.2.

4.6.4.3 Attenuation uniformity. The attenuation uniformity of each individual fiber shall be measured in accordance with EIA-455-59. The uniformity shall be measured from one end of the fiber, and shall meet the requirements specified in 3.6.1.3.

4.6.4.4 Numerical aperture. The numerical aperture shall be determined in accordance with EIA-455-47 or equivalent (see 4.6.1), and shall meet the requirements specified in 3.6.1.4.

4.6.4.5 Bandwidth-distance product. The multimode fiber bandwidth-distance product shall be determined in accordance with EIA-455-51 or equivalent (see 4.6.1) using the light launch conditions of EIA-455-54. The bandwidth-distance product shall meet the requirements specified in 3.6.1.5.

4.6.4.6 Macrobend attenuation. The macrobend attenuation of each individual fiber shall be measured in accordance with EIA-455-62. The mandrel radius used shall be 3.8 centimeters (cm) and the number of turns used shall be 100. Launch conditions shall be in accordance with 4.6.4.1.1. Macrobend attenuation shall meet the requirements specified in 3.6.1.6.

4.6.4.7 Mode field diameter. The mode field diameter of types SU, SS, and SF fiber shall be determined in accordance with EIA-455-164 or equivalent (see 4.6.1), and shall meet the requirements specified in 3.6.1.7.

4.6.4.8 Dispersion. The dispersion characteristics for types SU, SS, and SF fiber shall be determined in accordance with EIA-455-168 or equivalent (see 4.6.1), and shall meet the requirements specified in 3.6.1.8.

4.6.4.9 Cut-off wavelength. The cut-off wavelength of types SU, SS, and SF fiber shall be determined in accordance with EIA-455-80 or equivalent (see 4.6.1), and shall meet the requirements specified in 3.6.1.9.

4.6.4.10 Transient attenuation. The transient attenuation of type MM fiber sample shall be measured in accordance with EIA-455-46 at 1.310 ± 0.020 μm using overfilled conditions without mode filter or cladding mode stripper. The sample shall be cut back at 50-meter intervals repeatedly. Light launch conditions used during the test shall be uniform overfill. The transient loss shall be calculated as follows: Plot the cumulative overfill loss versus length. Subtract from that curve the cumulative steady state, that is, equilibrium modal power distribution condition, loss as calculated from the attenuation rate as specified in 4.6.4.2. The resultant curve is the cumulative transient loss as a function of length. The maximum transient loss is defined as the maximum value of the transient loss curve over the sample test length. Transient attenuation shall be as specified in 3.6.1.10.

4.6.5 Mechanical properties.

4.6.5.1 Torsion. The fiber shall be tested in accordance with EIA-455-63. The test length shall be 10 meters and the twist angle shall not exceed 15 degrees. The tensile load shall be 350 MPa, and the total torque shall be 25 Newton-centimeters (N-cm). The change in optical transmittance shall be measured during and after this test and shall be as specified in 3.6.2.1.

4.6.5.2 Flexure. The fibers shall be tested in accordance with EIA-455-65. The test length shall be 10 meters and the test temperature shall be the low operating temperature. The test shall consist of 25 cycles of five turns about a 30-millimeter (mm) mandrel. The change in optical transmittance shall be measured during and after this test, and shall be as specified in 3.6.2.2.

4.6.6 Environmental properties.

4.6.6.1 Thermal shock. The fibers shall be tested in accordance with EIA-455-71 using the test conditions and order specified in table XII.

TABLE XII. Thermal shock tests.

Step	Temperature (°C)	Exposure time
1	-62^{+0}_{-3}	3 hours maximum 2 hours minimum
2	+25 ± 2	5 minutes maximum
3	$+85^{+3}_{-0}$	3 hours maximum 2 hours minimum
4	+25 ± 2	5 minutes maximum
5	Repeat steps 1 through 4 nine times (10 cycles)	

The change in optical transmittance shall be measured after exposure (see 4.6.4.1). The fiber shall meet the requirements specified in 3.6.3.1.

4.6.6.2 Temperature-humidity cycling. The fibers shall be tested in accordance with EIA-455-73. The temperature shall be the operating temperature extremes and the relative humidity shall be 95 percent. The change in optical transmittance shall be measured during and after exposure (see 4.6.4.1). The fiber shall meet the requirements specified in 3.6.3.2.

4.6.6.3 Accelerated aging. The fibers shall be tested in accordance with EIA-455-70. The test temperatures (A5) shall be plus 110 degrees Celsius (°C), with a tolerance of plus 3°C, and minus 0°C; the time (B9) shall be 240 hours; and the frequency (C2) shall be daily. The change in optical transmittance shall be measured after exposure (see 4.6.4.1). The fiber shall meet the requirements specified in 3.6.3.3.

4.6.6.4 Nuclear radiation resistance. The fibers shall be tested in accordance with EIA-455-49. Recovery of fibers shall be monitored continuously after removal from the radiation field. The fibers shall be tested at 1.310 ± 0.020 μm. Data shall be determined for the low operating temperature, 20°C, and the high operating temperature. The dose rate shall be 25 rads/second. The change in optical transmittance shall be measured during and after exposure (see 4.6.4.1). The fiber shall meet the requirements specified in 3.6.3.4.

4.6.7 Inspection of packaging. The sampling and inspection of the preservation, packaging, and container marking shall be in accordance with the requirements of MIL-C-12000.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Packaging. Packaging shall be in accordance with MIL-C-12000.

5.2 Reels and spools. Reels and spools shall be stable over the storage temperature range.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The optical fibers covered by this specification are intended for use in any application where their performance characteristics are required. The fibers are for installation in shipboard systems within the limitations of applicable performance requirements.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of the specification.
(b) Issue of DoDISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(c) Applicable specification sheet number, title, and date.
(d) When first article is required (see 3.2).
(e) Quantity of fiber required.
(f) Minimum acceptable continuous length (see 3.5.1).
(g) Location of identification marking, if other than as specified (see 3.7).
(h) Color code coating of the optical fiber, if specified (see 3.7).
(i) High storage temperature of reels if greater than 55°C (see 3.6.3).
(j) Equivalent test methods, if other than as specified (see 4.6.1).
(k) Applicable specification sheet part number (see 6.7).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DIDs) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.6.3.1 and appendix B	DI-MISC-80653	Test reports	-----

The above DIDs were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on the DD Form 1423.

6.4 First article. When a first article inspection is required, the items should be a first article sample. The first article should consist of three units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Definitions. The following definitions of terms in this document are generally accepted by the optical fiber cable manufacturing industries.

6.5.1 Attenuation. Attenuation is the diminution of optical power as light travels along an optical path.

6.5.2 Attenuation rate. Attenuation rate is the diminution of average optical power along a length of optical fiber normalized to what the diminution would be for a standard length (usually 1 km). To be meaningful, the rate of diminution along the sample length should be uniform. For a sample length of L km and an input power P_i resulting in an output power P_o, the attenuation rate (AR) is:

$$AR = [10 \log_{10} (P_i/P_o)]/L \qquad (\text{dB/km})$$

6.5.3 Bandwidth-distance product. The bandwidth-distance product of an optical fiber is that value numerically equal to the lowest modulation frequency at which the optical power of the baseband transfer function of the fiber decreases to a single fraction, usually one half, of the zero frequency value normalized to a 1-km reference length, normally expressed as MHz-km. The transfer function is the ratio of the two complex quantities (Fourier or Laplace transforms) characterizing the optical power as a function of frequency at the output and corresponding input of the fiber.

6.5.4 Buffered fiber. A buffered fiber is a coated optical fiber augmented with an additional coating or buffer jacket to protect the fiber and render it more visible and manageable.

6.5.5 Cladding. Cladding is the dielectric material of an optical fiber surrounding the fiber core and whose outer surface is protected by the fiber coating.

6.5.6 Cladding noncircularity. The cladding noncircularity is the measure of the degree of roundness of the cladding. It is expressed as the difference between the largest cladding diameter and the cladding diameter measured at right angles to it, all divided by the average of the two values.

6.5.7 Coating. A coating is a protective material bonded to an optical fiber over the cladding for various purposes, such as preserving fiber strength, inhibiting cable losses, and protecting against mechanical damage.

6.5.8 Core/cladding offset. The core/cladding offset is the distance between the central axis of the core and the central axis of the cladding.

6.5.9 Core noncircularity. The core noncircularity is the measure of roundness of the core. It is expressed as the difference between the largest core diameter and the core diameter measured at right angles to it, all divided by the average of the two values.

6.5.10 Cut-off wavelength. Cut-off wavelength, in a single-mode fiber, is the minimum wavelength at which the second order LP11 ceases to propagate.

6.5.11 Depressed cladding. Depressed cladding is cladding in which the region adjacent to the core has a refractive index less than that of outer regions.

6.5.12 Dispersion-flattened fiber. Dispersion-flattened fiber is considered to be one which has a dispersion value that is low over the wavelength region of 1.29 to 1.57 μm.

6.5.13 Dispersion-unshifted single-mode fiber. Dispersion-unshifted single-mode fiber is considered to be one whose dispersion curve is monotonically increasing, with a single crossing of the zero dispersion axis in the vicinity of 1.30 μm.

6.5.14 Dispersion-shifted single-mode fiber. Dispersion-shifted single-mode fiber is considered to be one whose dispersion curve is monotonically increasing, with a single crossing of the zero dispersion axis in the vicinity of 1.55 μm.

6.5.15 Fiber/coating offset ratio. Fiber (core/cladding) to coating offset ratio is determined by measuring the minimum wall thickness (t_{min}) and the maximum wall thickness (t_{max}) and dividing the minimum by the maximum value (see figure 1).

6.5.16 Fiber core. The fiber core is the central region of an optical fiber which guides the transmission of light.

6.5.17 Matched cladding. Matched cladding is fiber composed of a single homogeneous layer of dielectric material.

6.5.18 Multimode fiber. A multimode fiber is an optical fiber that will allow more than one bound mode to propagate.

6.5.19 Optical fiber. An optical fiber is the core, cladding, and coatings applied during the fiber drawing process.

6.5.20 70/70 restricted launch. A 70/70 restricted launch is a beam optics launch with a 70 percent spot size and source aperture equal to 70 percent of the fiber numerical aperture.

6.5.21 70/100 restricted launch. A 70/100 restricted launch is a beam optics launch with a 70 percent spot size and source aperture equal to or greater than the fiber numerical aperture.

6.5.22 Single-mode fiber. A single-mode fiber is an optical fiber in which only one bound mode can propagate at the wavelength of interest.

6.5.23 Transient attenuation. Transient attenuation, in multimode fiber, is the increase (or decrease) in attenuation from the steady-state attenuation because of the over (or under) excitation of the lossy high order propagating modes compared with the steady-state distribution. The steady-state distribution is the condition in which the relative power distribution among the propagating modes is independent of longitudinal distance.

6.6 Material safety data sheets (MSDS). Contracting officers must identify those activities requiring copies of MSDS's. Additional required Government information is contained in FED-STD-313. In order to obtain the MSDS, FAR clause 52.223-3 must be in the contract.

6.7 Part or Identifying Number (PIN). Optical fibers should contain only the following:

M49291/ XX XXX

Optical fiber basic specification — M49291/

Optical fiber specification sheet — XX

Serial number — XXX

Examples:

M49291/06-006
M49291/07-007

6.8 Part designator. A part designator, if specified (see 3.1), should include classifications (see 1.2) as follows:

(1) Optical fiber type (see 1.2.1).
(2) Optical fiber core and cladding diameter (see 1.2.2).

Example: SUA.

6.9 Subject term (key word) listing.

Aperture, numerical
Attenuation
Bandwidth-distance product
Cut-off wavelength
Diameter, mode field
Dispersion
Fiber optic communications
Fiber optic component
Geometry
Optical fiber
Wavelength

Review activities:
Navy - EC, YD

Preparing activity:
Navy - SH
(Project 6010-N004)

APPENDIX A

TEST PROCEDURE FOR COATING GEOMETRY MEASUREMENT FOR OPTICAL FIBER SIDE-VIEW METHOD

10. SCOPE

10.1 Scope. This method is intended for off-line measurement of the coated fiber outside diameter, the overall and primary coating concentricity ratios, and the coating noncircularity. Only the dimensions of the protective coatings are covered. This appendix is a mandatory part of this specification.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TEST EQUIPMENT

30.1 Test equipment. The test equipment required for this test procedure shall be as specified in 30.2 through 30.5.

30.2 Microscope. Any general use microscope with transmitted and reflected light capability, which has a stage suitable and robust enough for mounting the coating test fixture, may be used. The total magnification of the microscope shall be a minimum of 160X for coatings whose nominal outside diameter is not greater than 300 μm and a minimum of 100X for coatings whose nominal outside diameter is not greater than 500 μm but greater than 300 μm. The microscope objective shall provide a sufficient free working distance to accommodate the test fixture.

30.3 Measurement equipment. Either a video micrometer or a filar micrometer with a readout of sufficient range is suitable for this application.

30.4 Calibration equipment. Any calibration standard such as a reflected light stage micrometer with sufficiently small graduations is suitable for use.

30.5 Coating test fixture. The test fixture allows the inspection of a coated optical fiber along its axis. The fiber is submerged in an immersion fluid. The fixture shall be matched to the microscope used such that the depth of the fixture is suitable to the free working distance of the objective. Care shall be taken that the depth that the fiber is submerged in the fluid remains constant, no bubbles are present which will distort the measurement, and steps are taken to remove the meniscus. The fiber sample shall easily be placed into the test fixture in an unflexed position.

30.6 Immersion fluid. Clear immersion liquid with an index of refraction sufficiently near the index of refraction of the cured outer coating to allow viewing shall be used.

40. TEST SPECIMEN

40.1 Test specimen. A fiber test specimen of sufficient length to fit in the test fixture and allow measurement of the desired parameters is required. Clean the fiber sample. Dirty fiber may give incorrect test results. If the fiber is noncolored or transparent, all appropriate dimensions can be measured following the procedure below. If the fiber is color-coded or opaque, only the outside diameter and the noncircularity of the fiber can be measured utilizing these techniques. If more information is required on the fiber specimen, the color-coding shall be removed using suitable techniques.

50. TEST PROCEDURE

50.1 Test procedure.

(a) Load fiber into fixture.

(1) Verify the test fixture and immersion fluid is clean before loading the fixture.
(2) Insert the coated fiber sample into the test fixture.

(b) Dual coated fiber.

(1) Calibrate the system by measuring a suitable section of the calibration standard and adjust the equipment to get the correct value on the display. Repeat the procedure to check equipment calibration.
(2) Adjust the microscope to focus the sample.

Note: The best focus is obtained by adjusting for a single distinct line on the outer surface of the coating. Interfaces 2, 3, 4, and 5 have width and cannot be focused to a single distinct line. The hairline of the measurement equipment shall be placed consistently throughout the duration of the test. Do not refocus during the test. If the sample appears to vibrate in the microscope, check for an improper level of immersion fluid.

(3) Rotate the sample in the fixture while viewing the magnified image until the minimum overall wall thickness, the secondary and primary layers combined, is shown in the microscope or video monitor. See figure 2 for location of the primary and secondary layers. While in the plane showing the minimum overall wall thickness, move the hairline of the measurement equipment from interface 1 to interface 3, and from interface 6 to interface 4. These measurements will yield the minimum and corresponding opposite overall wall thicknesses of the coatings.
(4) Rotate the sample in the fixture while viewing the magnified image until the minimum wall thickness of the primary layer is shown in the microscope or video monitor. While in the plane showing the minimum thickness of the primary layer, move the hairline of the measurement equipment from

interface 2 to interface 3, and from interface 5 to interface 4. These measurements will yield the minimum and corresponding opposite wall thickness of the primary coating.

(5) Rotate the sample in the fixture while viewing the magnified image until the maximum outside diameter of the coated fiber is shown in the microscope or video monitor. While in the plane showing the maximum outside diameter of the coated fiber, move the hairline of the measurement equipment from interface 1 to interface 6.

(6) Rotate the sample in the fixture while viewing the magnified image until the minimum outside diameter of the coated fiber is shown in the microscope or video monitor. While in the plane showing the minimum outside diameter of the coated fiber, move the hairline of the measurement equipment from interface 1 to interface 6.

(c) Single-coated fiber.

(1) Calibrate the system by measuring a section of the calibration standard and adjust the equipment as required to get the correct value on the display. Repeat the procedure to check equipment calibration.

(2) Adjust the microscope to focus the sample.

Note: The best focus is obtained by adjusting for a single distinct line on the outer surface of the coating. Interfaces 2 and 3 have width and cannot be focused to a single distinct line. The hairline of the measurement equipment shall be placed consistently throughout the duration of the test. Do not refocus during the test. If the sample appears to vibrate in the microscope, check for improper level of immersion fluid.

(3) Rotate the sample in the fixture while viewing the magnified image until the minimum wall thickness of the coating is shown in the microscope or video monitor. See figure 3 for location of the coating layer. While in the plane showing the minimum wall thickness of the coating, move the hairline of the measurement equipment from interface 1 to interface 2, and from interface 4 to interface 3. The measurements will yield the minimum and corresponding opposite wall thicknesses of the coating.

(4) Rotate the sample in the fixture while viewing the magnified image until the maximum outside diameter of the coated fiber is shown in the microscope or video monitor. While in the plane showing the maximum outside diameter of the coated fiber, moved the hairline of the measurement equipment from interface 1 to interface 4.

(5) Rotate the sample in the fixture while viewing the magnified image until the minimum outside diameter of the coated fiber is shown in the microscope or video monitor. While in the plane showing the minimum outside diameter of the coated fiber, move the hairline of the measurement equipment from interface 1 to interface 4.

50.2 Calculations.

50.2.1 Dual-coated fiber. For dual-coated fiber, the following calculations shall apply:

(a) Overall coating concentricity ratio (see 50.1(b)(3)).

$$\text{OCCR} = \frac{\text{minimum overall coating wall thickness}}{\text{overall coating wall thickness opposite the minimum}}$$

(b) Primary coating concentricity ratio (see 50.1(b)(4)).

$$\text{PCCR} = \frac{\text{minimum primary coating wall thickness}}{\text{primary coating wall thickness opposite the minimum}}$$

(c) Coating noncircularity (see 50.1(b)(5) and 50.1(b)(6)).

$$\text{CN} = \frac{2(\text{maximum outside diameter} - \text{minimum outside diameter})}{\text{maximum outside diameter} + \text{minimum outside diameter}} \times 100$$

(d) Coating diameter (see 50.1(b)(5) and 50.1(b)(6)).

$$\text{CD} = \frac{\text{maximum outside diameter} + \text{minimum outside diameter}}{2}$$

50.2.2 Single-coated fiber. For single-coated fiber, the following calculations shall apply:

(a) Coating concentricity ratio (see 50.1(c)(3)).

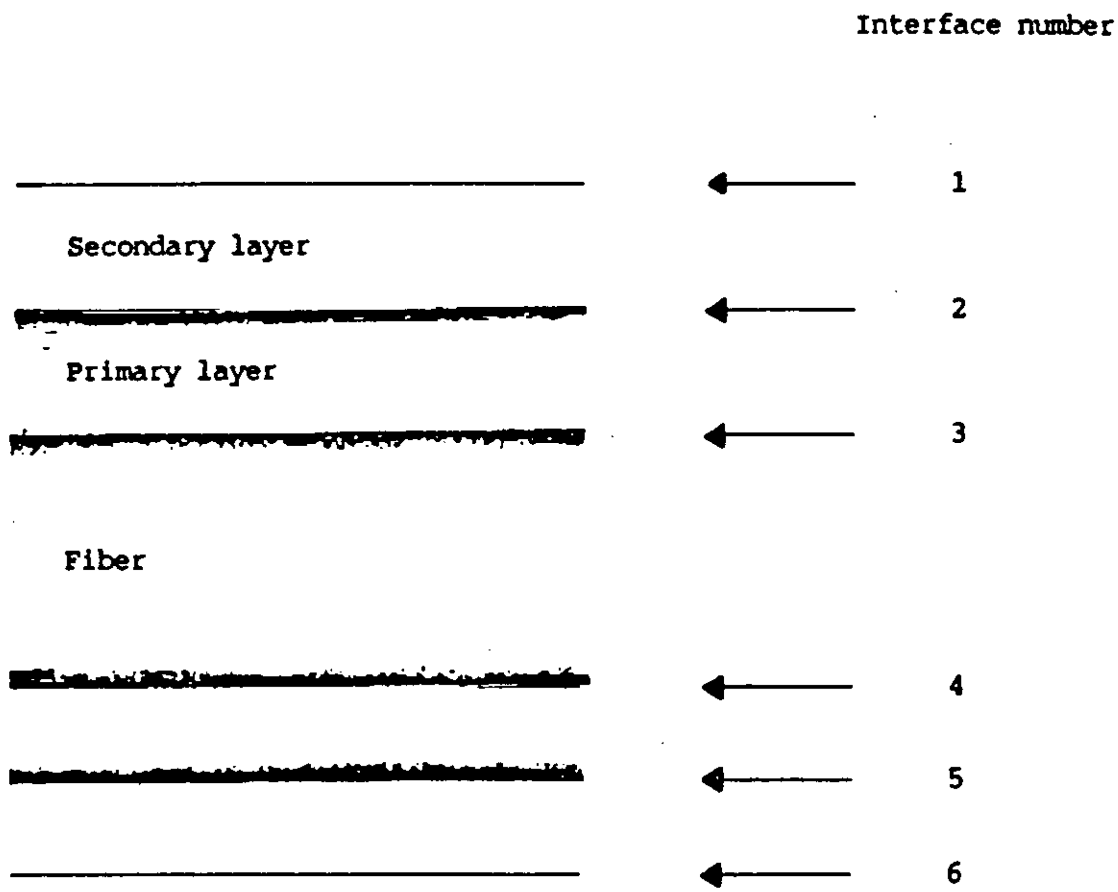
$$\text{CCR} = \frac{\text{minimum coating wall thickness}}{\text{coating wall thickness opposite the minimum}}$$

(b) Coating noncircularity (see 50.1(c)(4) and 50.1(c)(5)).

$$\text{CN} = \frac{2(\text{maximum outside diameter} - \text{minimum outside diameter})}{\text{maximum outside diameter} + \text{minimum outside diameter}} \times 100$$

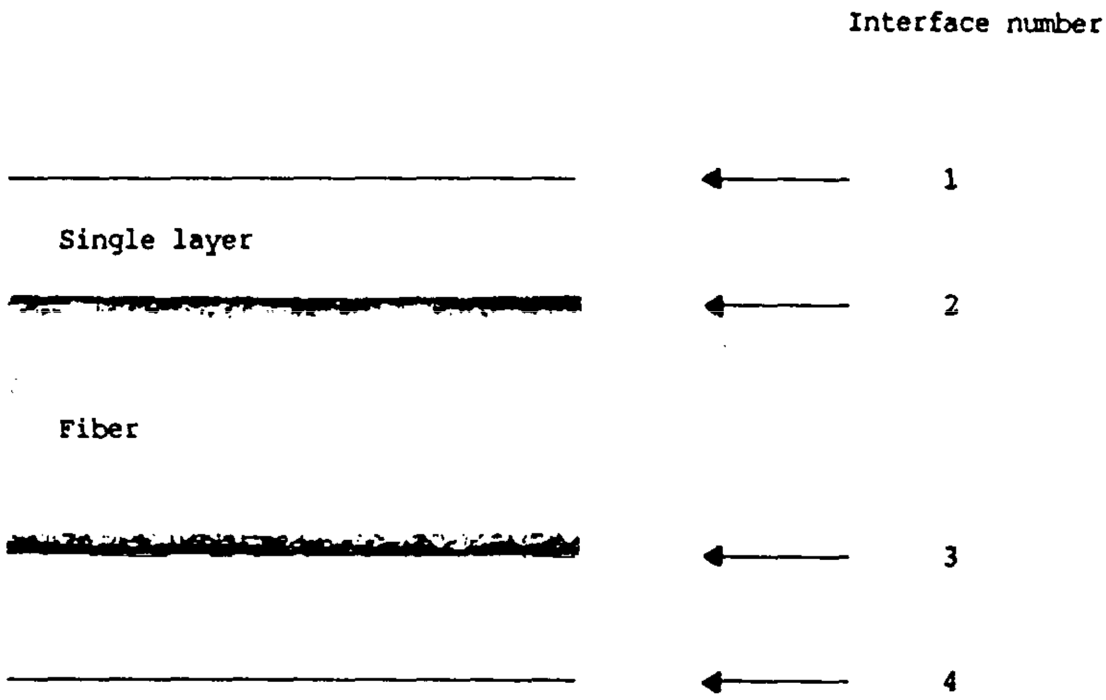
(c) Coating diameter (see 50.1(c)(4) and 50.1(c)(5)).

$$\text{CD} = \frac{\text{maximum outside} + \text{minimum outside diameter}}{2} \times 100$$



SH 13232041

FIGURE 2. Typical dual-coated fiber.



SH 13232042

FIGURE 3. Typical single-coated fiber.

APPENDIX B

TEST REPORTS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the information that shall be included on test reports when required by the contract or order. This appendix is applicable only when data item description DI-MISC-80653 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TEST REPORTS

30.1 Coating geometry measurement report. When required by the contract or order, the coating geometry measurement report shall contain the following information.

(a) Date of test.
(b) Test sample identification.
(c) Test results for dual-coated fiber, including:

(1) Overall coating concentricity.
(2) Primary coating concentricity ratio.
(3) Coating noncircularity.
(4) Coating diameter.

(d) For single-coated fiber:

(1) Coating concentricity ratio.
(2) Coating noncircularity.
(3) Coating diameter.

(e) Brief description of the test equipment, including the following:

(1) Microscope, magnification used, manufacturer, model number, and accessories pertinent to the measurement.
(2) Test fixture.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-F-0049291A(NAVY)	FIBER, OPTICAL, GENERAL SPECIFICATION FOR (METRIC)

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)* ☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: ______
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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